**Circuit 1: RC Phase shifting** You will reconstruct the series RC circuit that was used during experiment #3. Measure whatever parameters you deem necessary with whatever equipment the school can provide to measure the reactance of the capacitor and the phase shift it generates between the current and the voltage waveforms. Research the topic of [**Lissajous figures**](https://en.wikipedia.org/wiki/Lissajous_curve) and measure them for this circuit. Does the data from this observation compare well with other data collected above? What is the common use of this technique? Choose your R and C values carefully to encourage a sensible phase shift of current and voltage (You are permitted to alter the parameters of both R, C and f to obtain a reasonable Lissajous Figure. However, you are still expected to show what the phase shift would have been with the components from your Lab 3 experiment. If the phase shift of these is acceptable then fine otherwise predict and show that it is small and then choose new components to complete this part of the experiment). Your theoretical knowledge should guide you here. The values of these components have to be carefully chosen to permit impedance matching. You should research this before entering the lab. The results of this computation should also be included in your   
analysis.

**Circuit 2: CLR Circuit.** Now connect a CLR circuit with components whose impedance with match the output of the function generator and predict the natural frequency of this circuit. (Show the reasoning here in your report please.) Make a plot of frequency amplitude v. frequency and see if your resonance point is in fact the natural frequency. Some analysis of your curve should be effected to obtain the mathematically sound maxima here.

**Circuit 3:** **Transformer** Using the coils and magnetic cores provided by the school make a rudimentary transformer. Starting with a low frequency of 20 Hz increase the frequency of the input voltage until the output voltage drops off considerably. It should be much higher. Why does this happen? Where does all the energy go?

**Circuit 4:** **Solenoid** Using the hall effect probe (magnetic field sensor) and DC power source of a low enough voltage to keep the current in the coil at a safe level (i.e. 1.5 V) measure the B field inside the solenoid and also along it longitudinal axis. Compare the values you obtained with those predicted by the theory describing your circuit. Consider using the [Helmholtz coils](https://en.wikipedia.org/wiki/Helmholtz_coil) for this

**Challenging Extension:** Energize a second solenoid whose B field is similar, but not necessarily exactly the same as the first one. Place the second solenoid proximate to the first one at an arbitrary angle well of the axis. Compute the theoretical B field in R3 as it is distorted by the two solenoids. You are expected to model this via a computational solution of your fabrication using any software platform you like, with the exception that you cannot use a physics simulator (unless you wrote it yourself) as the primary solution calculator. You can use one to verify the results of your own work. If you are unsure about the spirit of this please   
see me.

**NOTE**: Proper solutions to this challenging aspect can earn up to 110% on this paper. However, papers that do not meaningfully undertake this aspect will not receive a grade in excess of 90%.